

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

## **IMAGES ARE BEST AVAILABLE COPY.**

As rescanning documents *will not* correct images,  
Please do not report the images to the  
Image Problem Mailbox.

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : **07-171478**  
 (43)Date of publication of application : **11.07.1995**

(51)Int.CI.  
 B05C 11/08  
 B05C 13/02  
 H01L 21/027  
 H01L 21/68

(21)Application number : **05-345150** (71)Applicant : **DAINIPPON SCREEN MFG CO LTD**

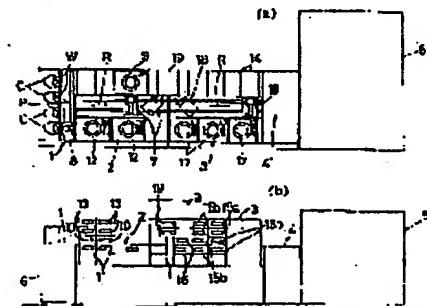
(22)Date of filing : **20.12.1993** (72)Inventor : **KOYAMA YOSHIHIRO**

## **(54) SUBSTRATE TREATING DEVICE**

### **(57)Abstract:**

PURPOSE: To improve treating efficiency while reducing the size over the entire part of the device.

CONSTITUTION: Two pieces of third cooling treatment sections 19, 19 for parallel treatment are installed between a first treatment unit 2 having a first substrate transporting means 7 capable of transporting a substrate W in a horizontal direction and a second treatment unit 3 having a second substrate transporting means 18 capable of transporting the substrate W in a horizontal direction. The treating device is so constituted that the substrate W is carried into the third cooling treatment sections 19, 19 and is ejected out of these sections respectively by the first and second substrate transporting means 7, 18.



**\* NOTICES \***

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

**DETAILED DESCRIPTION****[Detailed Description of the Invention]****[0001]**

[Industrial Application] this invention is conveyed in the predetermined substrate processing section while it conveys substrates, such as a semiconductor wafer, a glass substrate for liquid crystal displays, and a glass substrate for photo masks, among various kinds of processing units, and to the substrate, carry out application processing of the photoresist liquid, exposure processing is carried out, or it relates to a substrate processor, such as carrying out the development of the photoresist applied to the substrate.

**[0002]**

[Description of the Prior Art] In this kind of substrate processor, a substrate conveyance means to convey a substrate horizontally is conventionally prepared in each of various kinds of processing units general. And when preparing the interface section between processing units and conveying a substrate from one processing unit to the processing unit of another side Once, convey a substrate in the interface section by the substrate conveyance means of one processing unit, and it is made to catch, and it is constituted so that the substrate may be taken out by the substrate conveyance means of the processing unit of another side and may be delivered.

[0003] However, since the interface section is intervened between each processing unit There is a problem which the whole equipment enlarges and time excessive for delivery in the interface section is needed. For example, when it is said that an aligner is worked without a loss etc., exposure processing is finished by the aligner and a substrate is taken out The following substrate had to be supplied to the aligner, and since it said that the substrate with which pretreatment was able to be managed between the processing times in an aligner was obtained etc., there was un-arranging [ that the number of the units in pretreatment had to be made / many ].

[0004] Then, while carrying out the \*\* tone of the substrate carried in from the 1st equipment between the 1st equipment which applies and heats a resist to a substrate like JP,4-84410,A in order to enable it to avoid enlargement of the equipment resulting from mediation of the interface section, and the 2nd equipment which exposes the substrate to which the resist was applied, there are some which prepared one \*\* tone stage which performs centering.

**[0005]**

[Problem(s) to be Solved by the Invention] However, when the time which processing with the 2nd equipment which exposes a substrate takes in the case of the above conventional examples was shorter than the time which the \*\* tone of a substrate takes, it originated in processing on a \*\* tone stage, the loss was produced at the operation time of the 2nd equipment, and there was a fault which cannot avoid decline in processing efficiency even if enlargement of equipment is avoidable.

[0006] It aims at this invention being made in view of such a situation, shortening substrate conveyance time, while the substrate processor of invention which relates to a claim 2 for the purpose of enabling it to improve processing efficiency while the substrate processor of invention concerning a claim 1 can miniaturize the whole equipment can do the whole equipment in a compact further, and enabling it to improve processing efficiency further.

**[0007]**

[Means for Solving the Problem] In order to attain the above purposes, the substrate processor of

invention concerning a claim 1 Between the 1st processing unit which has the 1st substrate conveyance means which can convey a substrate horizontally, and the 2nd processing unit which has 2nd substrate conveyance means by which the aforementioned substrate can be conveyed horizontally While carrying in a substrate at least by one side of the 1st and 2nd substrate conveyance meanses, another side prepares and constitutes the substrate processing section for two or more parallel processing which takes out a substrate.

[0008] Moreover, the substrate processor of invention concerning a claim 2 In the 1st processing unit of the substrate processor of invention which relates to the above-mentioned claim 1 in order to attain the above purposes Have the substrate processing section on each of both sides which sandwiched the horizontal moving trucking which goes in the side-by-side installation direction with the 2nd processing unit of the 1st substrate conveyance means, and it sets to the 2nd processing unit. It constitutes so that it may have the substrate processing section on each of both sides which sandwiched the horizontal moving trucking which goes in the side-by-side installation direction with the 1st processing unit of the 2nd substrate conveyance means.

[0009]

[Function] [ after performing another processing in the substrate processing section, when processing the substrate processed in the 1st processing unit in the 2nd processing unit according to the composition of the substrate processor of invention concerning a claim 1 ] While performing delivery to the 1st processing unit [ 2nd ] from a processing unit through the substrate processing section Even when the processing time over the substrate in each substrate processing section is longer than the processing time over the substrate in the 2nd processing unit by preparing two or more the substrate processing sections, and carrying out parallel processing It chooses and takes out, and the substrate which processing ended suitably can be promptly supplied to the 2nd processing unit, and it can be made to process [ from ] it among two or more substrate processing sections.

[0010] Moreover, according to the composition of the substrate processor of invention concerning a claim 2, it sets to each the 1st and 2nd processing units. For example, the substrate processing sections, such as the substrate processing section for a resist application, and the substrate processing section for cooling in a subsequent heating row While distributing in between by carrying out horizontal moving trucking of each the 1st which goes in the side-by-side installation direction of the 1st and 2nd processing units, and 2nd substrate conveyance meanses, approaching mutually and being able to arrange Mileage between services of the substrate between the substrate processing sections by each the 1st and 2nd substrate conveyance meanses can be shortened.

[0011]

[Example] Next, the example of this invention is explained in detail based on a drawing:

[0012] Drawing 1 is the whole outline perspective diagram showing the example of the substrate processor concerning this invention.

[0013] This substrate processor is equipment for carrying out a development to an exposure row, while carrying out application processing of the photoresist liquid to the substrates W, such as a semiconductor wafer, a glass substrate for liquid crystal displays, and a glass substrate for photo masks. The indexer unit 1 which roughly divides and keeps an unsettled substrate and a processed substrate; The 1st processing unit 2 equipped with various kinds of substrate processing sections which heat-treat [ washing processing ] and process [ resist application ] Substrate W, It consists of the 2nd processing unit 3, interface 4, and exposure unit 5 (refer to drawing 2 ) equipped with edge exposure processing and a development, and various kinds of substrate processing sections to heat-treat.

[0014] The indexer unit 1 consists of indexer carrier robots 8 which carry Substrate W between the substrate delivery position P of the pedestal 6 of the fixation which lays the cassette C which contains Substrate W in a single-tier state, and 1st substrate conveyance means 7 to mention later while taking Substrate W to Cassette C, and each cassette C. The aforementioned cassette C -- Inside, Substrate W can be contained now to multi-stage, respectively.

[0015] To the 1st processing unit 2, as shown in the whole (a) plan of drawing 2 , and whole (b) outline drawing of longitudinal section of drawing 2 The one washing processing section 9 which

supplies a penetrant remover to the front face while rotating Substrate W, The hydrophobing processing sections 10 and 10 of the couple installed horizontally [ in order to carry out hydrophobing processing of the front face of the substrate after washing processing ], the hydrophobing processing sections 10 and 10 -- with each 1st cooling processing section 11 and 11 which is prepared caudad and cools the substrate W after hydrophobing processing The application processing sections 12 and 12 of the couple installed horizontally [ in order to carry out application processing of the photoresist liquid on the surface of a substrate ], Substrate W is conveyed in each processing section etc. with heat-treatment section 13 of \*\* a total of four 1st laid two steps at a time on aforementioned hydrophobing processing section 10 and 10, respectively --, and it has carrying in and the 1st substrate conveyance means 7 to take out.

[0016] The application processing sections 12 and 12 are distributed and arranged on both sides of the horizontal moving trucking R which turned to the side-by-side installation direction of the 1st of the 1st substrate conveyance means 7, and the 2nd processing unit 2 and 3 with the aforementioned washing processing section 9, the hydrophobing processing sections 10 and 10, and heat-treatment section 13 of \*\* 1st --.

[0017] The edge exposure processing sections 14 and 14 of the couple horizontally installed in the 2nd processing unit 3 side by side, A couple every horizontally The 2nd two heat-treatment section 15a and 15a and heat-treatment section 15b[ of \*\* six 3rd ] -- which were installed and were laid four steps at a time, respectively, Substrate W is conveyed in each processing section etc. with the 2nd cooling processing section 16 and 16 laid in two steps of upper and lower sides, and three developments sections 17 -- which is installed horizontally and carries out the development of the substrate W after exposure processing, and it has carrying in and the 2nd substrate conveyance means 18 to take out.

[0018] The aforementioned edge exposure processing sections 14 and 14, the 2nd, and 3rd heat-treatment section 15a, 15b-- and the 2nd cooling processing section 16 and 16, and development section 17 -- are distributed and arranged on both sides of the horizontal moving trucking R which turned to the side-by-side installation direction of the 1st of the 2nd substrate conveyance means 18, and the 2nd processing unit 2 and 3.

[0019] While 3rd heat-treatment section 15b of the washing processing section 9 of the 1st processing unit 2, and the 2nd processing unit 3, you make it located in some upper parts of the 2nd cooling processing section 16, and the 3rd cooling processing section 19 and 19 of two steps of upper and lower sides is formed. The controller box which carried out the interior of various kinds of controllers is shown by the inside B of drawing:

[0020] the above 1st and the 2nd substrate conveyance means 7 and 18 -- each forms the support arms 21 and 21 of the vertical couple which carries out installation maintenance of the periphery veranda of Substrate W respectively possible [ straight-line movement ] in the supporter material 20 in which rotation in movement in alignment with moving trucking R, rise and fall, and the level surface is possible, and is constituted these the 1st and 2nd substrate conveyance meansas 7 and 18 -- each is in the state which moved to the edge by the side of the \*\*\*\*\* unit 2 or 3, and it is constituted so that Substrate W can be taken out in a carrying-in row to the cooling processing sections 19 and 19 of the above 3rd In addition, it is made for the move direction of the support arm 21 to become right-angled with the moving trucking R of the supporter material 20, as the 1st and 2nd substrate conveyance meansas 7 and 18 drive the supporter material 20 and show it to (a) of drawing 2 as a solid line, when carried in and taking out a substrate to each processing unit 2 and each processing section in three. And a substrate is carried in and taken out by carrying out attitude movement of the support arm 21. In carrying in and taking out a substrate to the 3rd cooling processing section 19 and 19 to it, the supporter material 20 is driven and it makes it the move direction of the support arm 21 inclined by only the angle of 45 degrees as opposed to the moving trucking R of the supporter material 20, as a two-dot chain line shows to (a) of drawing 2. And a substrate is carried in and taken out by carrying out attitude movement of the support arm 21.

[0021] Next, a series of processing operation by the above-mentioned substrate processor is explained using drawing showing the relation between the flow of down stream processing of

drawing 3, and the processing time.

[0022] First, in the indexer unit 1 (IND and display), the unsettled substrate W is taken out from Cassette C by the indexer carrier robot 8, it conveys in the substrate delivery position P (S1), and one support arm 21 of the 1st substrate conveyance means 7 is passed. Moreover, if the processed substrate W is in the support arm 21 of another side of the 1st substrate conveyance means 7 <DP N=0004>, it will be received and conveyed and it will contain to Cassette C.

[0023] Subsequently, the 1st substrate conveyance means 7 conveys and washes Substrate W in the washing processing section 9 (SSW and display) from the substrate delivery position P (S2), after washing processing, Substrate W is conveyed in the hydrophobing processing section 10 (AH and display), and hydrophobing processing is carried out (S3).

[0024] After conveying Substrate W in the 1st cooling processing section 11 (CP and display), cooling after hydrophobing processing and returning even to (S4) and an ordinary temperature grade, Substrate W is conveyed in the application processing section 12 (SC and display), and photoresist liquid is applied to a substrate front face (S5).

[0025] Then, the substrate W which finished application processing is conveyed and heated in the 1st heat-treatment section 13 (H.P. and display) (S6), and subsequently to the 3rd cooling processing section 19 (CP and display), by the 1st substrate conveyance means 7, the substrate W after heat-treatment is conveyed, and it cools (S7), and returns even to an ordinary temperature grade.

[0026] Substrate W is taken out from the 3rd cooling processing section 19 by the 2nd substrate conveyance means 18 after cooling processing. Convey Substrate W in the edge exposure processing section 14 (EEW and display), and exposure processing to the periphery edge of Substrate W is performed in it (S8). After an appropriate time, Substrate W is conveyed to the exposure unit 5 (EXP and display), exposure to the whole substrate surface is performed to it, and Substrate W is conveyed and heated from (S9) at 2nd heat-treatment section 15a (H.P. and display) (S10).

[0027] The substrate W after the heat-treatment is conveyed in the 3rd cooling processing section 19 (CP and display), and it cools (S11), and after returning even to an ordinary temperature grade, the development of the substrate W is conveyed and carried out to the development section 17 (S12).

[0028] Substrate W is conveyed and heated after a development at 3rd heat-treatment section 15b (S13), and after an appropriate time, the substrate W after heat-treatment is taken out by the 2nd substrate conveyance means 18, and it once carries in in the 3rd cooling processing section 19 (S (IF and display) 14), it takes out with the 1st substrate conveyance means 7, and conveys to the substrate delivery position P. In addition, in this step S14, although Substrate W passes the 3rd cooling processing section 19, cooling processing is not performed. Namely, the pin (not shown) which penetrated the cooling plate (not shown) is prepared in the 3rd cooling processing section 19 possible [ rise and fall ]. Although cooling will be started if a pin descends and Substrate W is laid on a cooling plate after this pin receives and supports Substrate W from the support arm 21 of each substrate conveyance meanses 7 and 18 In this step S14, the 1st substrate conveyance means 7 receives and takes out Substrate W from a pin, without the pin descending, if Substrate W is passed to the aforementioned pin from the 2nd substrate conveyance means 18. In addition, although cooling processing is omitted in Step S14 in this example, in Step S14, you may be made to perform cooling processing.

[0029] And in the above operation, two support arms 21 and 21 of each substrate conveyance meanses 7 and 18 function as follows. That is, subsequently to before the washing processing section 9, the 1st substrate conveyance means 7 which received Substrate W on one support arm 21, for example in Step S1 moves. Then, already, in the washing processing section 9, the substrate [ finishing / washing processing ] W is received by the support arm 21 of another side, and the substrate W of aforementioned one support arm 21 is carried in to the vacant washing processing section 9 (S2). And the 1st substrate conveyance means 7 moves before the hydrophobing processing section 10, already, in the hydrophobing processing section 10, a substrate [ finishing / hydrophobing processing ] is received by aforementioned one support arm

21, and a substrate / finishing / washing processing of the support arm 21 of aforementioned another side ] is carried in to the vacant hydrophobing processing section 10 there (S3).

[0030] Each substrate conveyance meanses 7 and 18 have Substrate W in one side of two support arms 21 and 21 in this way, move between each processing section, and they repeat operation which carries in to the processing section the substrate W which it had in one support arm 21 while they receive and take out Substrate W from the processing section with the support arm of another side. The movement of each of these substrate conveyance meanses 7 and 18 becomes like the narrow arrow of the flow of drawing 3, and seven movements are repeated as one period respectively. And whenever each substrate conveyance meanses 7 and 18 move between each processing section, 1 \*\* will be every advanced about one substrate W. The movement of the substrate W becomes like the thick arrow of the flow of drawing 3. In addition, the number left-hand side in the box of the flow of drawing 3 shows the number of each processing section.

[0031] The processing time in each down stream processing is various as an example is shown drawing 3. The sake, In consideration of working the exposure unit 5 with a very expensive facility fully, supposing the required processing time over one substrate W of the exposure unit is 35 seconds The installation number of the processing section in each down stream process is set up so that one substrate W can be taken out from the down stream processing concerned by the processing time (35 seconds). For example, at the 1st heat-treatment section 13, it is even sheet to heating of the substrate W after the application of photoresist liquid. It totals with 10 seconds (delivery processing time) by carrying in and taking out of 120 seconds (process processing time) and Substrate W. It needs for 130 seconds (processing duration). Therefore, in which the ejection of Substrate W is possible is made into 32.5 seconds (parallel-processing duration), and it enables it to take out Substrate W within 35 seconds by making the 1st four treatment sections 13 have, shifting for every period of the 1st substrate conveyance means 7 heat-treating in order. The same is said of other substrate processing sections. In addition, the delivery processing time is the sum of delivery time with the substrate conveyance means 7, the time which rise and fall of the pin mentioned above take here.

[0032] Moreover, in the 3rd cooling processing section 19 and 19, in order to carry out cooling processing in parallel simultaneously in the delivery position from the processing unit 2 to the processing unit [ 2nd ] 3, compared with the case where the cooling processing section equivalent to Step S7 is prepared in the 1st processing unit 2, the time for delivery processing (for example 10 seconds) becomes unnecessary. furthermore, the 1st and 2nd processing units 2 and 3 -- the number of processes (S1-S7, S8-S14) which comes out, respectively -- each -- seven processes can do -- the number of times of conveyance -- it can decrease -- the conveyance time (with 1 of the transit time of each substrate conveyance meanses 7 and 18) for every process Each conveyance period is made at the 35 same seconds as the processing time in the exposure unit consequently one exposure unit 5 is received. if the sum with 1 time of delivery time with the processing section is 5 seconds -- the 1st and 2nd substrate conveyance meanses 7 and 18 -- substrate processor can only consist of having two processing units 2 and 3 and one interface case where the cooling processing section equivalent to Step S7 is prepared in the 1st processing unit 2 -- the time for delivery -- a draft -- it is too many needed, and the number of processes becomes eight processes, the conveyance period in one unit becomes 40 seconds, and it will reach at 35 seconds which is the processing time of the exposure unit 5 In this case, in order to decrease the number of processes which one substrate conveyance means takes charge of in order to process one substrate every 35 seconds, the number of substrate conveyance meanses need to be made to have to increase, the number of units had to be made to increase as a result, and the whole equipment was to be enlarged.

[0033] In addition, although the 3rd cooling processing section 19 is made to intervene as the substrate processing section for parallel processing between the 1st processing unit 2 and the processing unit 3 in the above-mentioned example As this invention, for example, it replace various kinds of substrate processing sections, such as the application processing section 12, 1st and 2nd heat-treatment sections 13 and 15, the 1st and 3rd cooling processing sections 19, and the development section 17, and can carry out.

[0034] The substrate processor of this invention is applicable not only to the above circular substrates W but the thing which processes the substrate of a square shape.

[0035]

[Effect of the Invention] As explained above, according to the substrate processor of invention concerning a claim 1 Parallel processing of the substrate is carried out in two or more substrate processing sections between the 1st processing unit and the 2nd processing unit. Even when the processing time over the substrate in each substrate processing section is longer than the processing time over the substrate in the 2nd processing unit The substrate which processing ended suitably is chosen and taken [ from ] out among two or more substrate processing sections. Since the 2nd processing unit can be supplied promptly and can be made to process While the interface of exclusive use for delivery of the substrate between the 1st processing unit and the 2nd processing unit was unnecessary and could miniaturize the whole equipment, the 2nd processing unit is worked without futility and processing efficiency could be improved.

[0036] Moreover, according to the composition of the substrate processor of invention concerning a claim 2, it sets to each the 1st and 2nd processing units. Horizontal moving trucking of each the 1st which goes in the side-by-side installation direction of the 1st and 2nd processing units, and 2nd substrate conveyance meanses is carried out in between. Since the substrate processing sections are distributed, it approaches mutually and it arranges, compared with the case where the substrate processing section is installed in the shape of a straight line, the whole equipment can be further constituted in a compact. Furthermore, mileage between services of the substrate between the substrate processing sections by each the 1st and 2nd substrate conveyance meanses can be shortened, it is easy to shorten the time which substrate conveyance takes, and processing efficiency can also be further improved now.

---

[Translation done.]

\* NOTICES \*

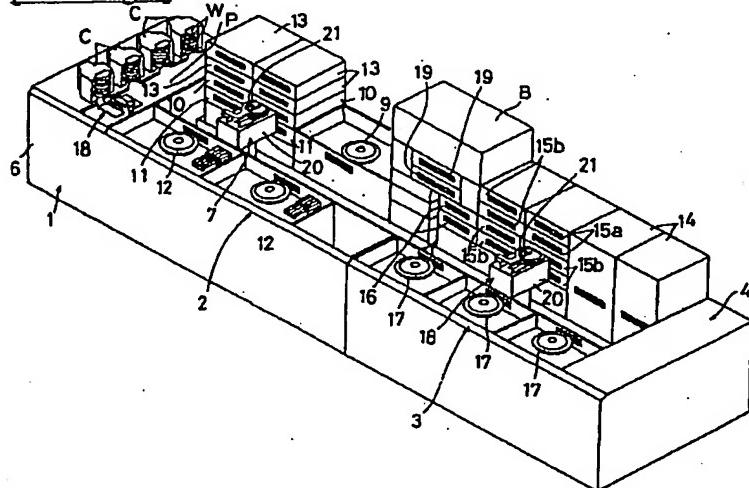
Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
  2. \*\*\*\* shows the word which can not be translated.
  3. In the drawings, any words are not translated.

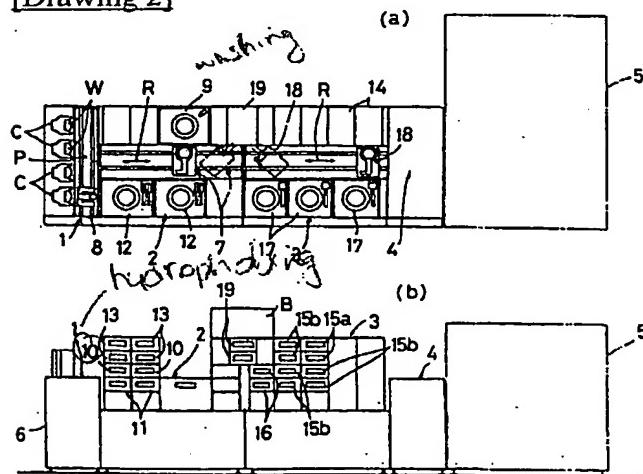
---

## DRAWINGS

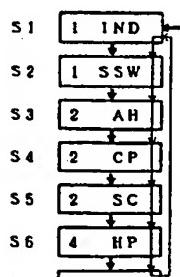
### Drawing 1



### [Drawing 2]



### [Drawing 3]



| プロセス<br>処理時間 | 受取<br>処理時間 | 処理<br>所要時間 | 並行処理<br>所要時間 |
|--------------|------------|------------|--------------|
| 22           | 4          | 26         | 26           |
| 25           | 10         | 35         | 35           |
| 60           | 10         | 70         | 36           |
| 60           | 10         | 70         | 35           |
| 40           | 10         | 50         | 25           |
| 120          | 10         | 130        | 32.5         |
|              |            |            |              |

|      |   |         |  |
|------|---|---------|--|
| S 7  | 2 | CP/(IP) |  |
| S 8  | 2 | E2W     |  |
| S 9  | 1 | EXP     |  |
| S 10 | 2 | HP      |  |
| S 11 | 2 | CP      |  |
| S 12 | 3 | SD      |  |
| S 13 | 6 | HP      |  |

|  | 60  | 10 | 70  | 35   |
|--|-----|----|-----|------|
|  | 50  | 10 | 60  | 30   |
|  | 35  | 0  | 35  | 35   |
|  | 60  | 10 | 70  | 35   |
|  | 60  | 10 | 70  | 35   |
|  | 90  | 10 | 100 | 33.3 |
|  | 180 | 10 | 190 | 31.1 |

---

[Translation done.]